IMPELLER FOR COOLANT PUMPS

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BACKGROUND OF THE INVENTION

This invention relates to a pump impeller for pumping a coolant and particularly for a water pump for cooling an internal combustion engine.

Water pumps for internal combustion engines are well known and are present in the larger internal combustion engines. A widely used water pump generally includes an impeller mounted within a housing. The impeller includes a plurality of spaced vanes secured on a round base. The impeller is secured to a drive shaft and is rotatably mounted within the walls of a pump housing. The housing includes an outer closure wall and a shroud over the outer ends of the impeller vanes. A one-piece fully enclosed and double shrouded impeller has been disclosed. However, the system of manufacture is expensive and involves a complex procedure requiring a special high maintenance die unit with a timed and multiple pull action such as found in a camera shutter. An alternative common impeller is a two-piece assembly in which a separate shroud is attached to the vanes of the impeller by a separate means, such as chemical bonding, sonic welding, or a mechanical connection. A one piece impeller with an integral shroud has been disclosed with a special arrangement and location of the shroud.

The water pumps for internal combustion engines generally operate in a high temperature environment. A seal unit is mounted with a bearing to the shaft at the base of the impeller. Cooling of the seal unit at the connection of the impeller shaft to the pump is significant. This requires special construction of the pump unit to maintain a long life assembly with minimum maintenance.

In summary, the prior art plastic impellers involve costly manufacturing procedures which involve costly equipment and various procedures or the cost of forming separate components with separate bonding of the separately bonded areas present areas of possible failure and should provide seal cooling means. The present systems do not therefore provide a structure which permits the manufacture of a relatively simple structure for controlling the volume of water flow and efficient seal cooling.

SUMMARY OF THE INVENTION

The present invention provides a one-piece impeller design including an in-place molded shroud, which may be formed with known injection molding apparatus, thereby permitting a particularly cost-effective impeller. The molded impeller is readily constructed with a proper height and vane curvature to produce a specified flow, in combination with a shroud and flow control constructed to create proper cooling of a pump seal. The single piece impeller provides a more optimum flow of the coolant around the mechanical seat of the impeller. The result is a reduction in the operating temperature of the pump seals, with an increased operating life of the seal and the pump.

More particularly, the impeller of the present invention includes a single piece impeller including a central shaft mounting hub and impeller vanes integrally formed on the periphery of the hub. The hub includes a base portion projecting outward between the vanes and functioning in combination with an integral shroud secured to the outer edges of the vanes. The shroud extends from an inner portion overlying the outer peripheral portion of the hub base portion and then outwardly to the outer edge of the vanes. The impeller is mounted to the housing having a base and an outer housing cover. A shaft and seal assembly is secured within the base with the impeller hub secured to the shaft and with the seal unit adjacent the hub. The housing base has a coolant chamber about the seal unit which projects radially beneath the impeller and in spaced relation to the hub base portion. The housing is closed by an outer cover including an outlet passageway aligned with the outlet or discharge openings defined by the radial outer ends of the vanes and the adjacent opposed wall of the housing base. The overlapping portions of the hub base portion and the shroud direct part of the flow into the cooling gap and chamber beneath the hub base portion and the housing base portion. The flow into the cooling chamber circulates through the cooling area and back to the vane passageway to the exit opening from the vanes into the coolant outlet passageway.

In summary, the present invention thus provides a one-piece molded pump impeller having a central rotating hub unit and an outer shroud connected by a plurality of vanes defining a multiple coolant flow forming part of and directed to a common

discharge or outlet passageway, with a portion of the flow circulated about a seal coolant chamber about the seal unit and to the backside of the rotating hub.

The impeller of the present invention is readily injection molded with well known injection molding equipment and with conventional plastics presently used in coolant pump impellers. The impeller of the present invention produces a highly cost-effective structure with both manufacturing and assembly costs, as well as an improved and long life assembly pump assembly.

Various other features, objects and advantages of the invention will be made apparent from the following description taken together with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings illustrate the best mode presently contemplated of carrying out the invention.

In the drawings:

Fig. 1 is a cross-section of a water pump illustrating a preferred embodiment of the invention;

Fig. 2 is a top view of the impeller shown in Fig. 1; and

Fig. 3 is a bottom view of an impeller shown in Fig. 1 of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawings and particularly to Fig. 1, a water pump 1 is illustrated which is particularly adapted for an internal combustion engine, 1a. The pump 1 includes an outer housing 2, including a base 3 and an outer cover 4, which are bolted to each other, as at 4a. A pump shaft 5 is rotatably mounted within the base 3. The shaft 5 is supported within the base 3 by a seal/bearing unit including a rotating bearing unit 6 and an inner shaft seal unit 7 that seals the bearing. The outer end of shaft 5 includes a driven member 8 which receives a driving belt 9 connected in a known connection to a rotating output of the engine, 1a. The shaft 5 extends inwardly of base 3 into the outer cover 4. A water pump impeller 10 is secured to shaft 5 by a coupling 11. The cover 4 is a cup-shaped housing overlying the base 3 and forming a pumping chamber 12 with a water inlet 12a. An encircling output passageway 13 is formed at the

outer peripheral connection of the outer cover 4 and the base 3. The outer passageway 13 includes a discharge opening 14.

The impeller 10 includes a central hub 15 secured to shaft 5 and an outer shroud 16 integrally connected to the hub 15 by a plurality of pump vanes 17. The impeller 10 is more fully shown in Figs. 2-3, and clearly illustrating a molded embodiment of the present invention. A vertical cross-sectional view of impeller 10 is illustrated in Fig. 1.

The impeller 10 includes the plurality of curved vanes 17 which are radially spaced about the impeller and with the inner end portions 18 of each vane connected with the hub 15.

Each vane 17 extended axially and circumferentially of the impeller. Each vane 17 is a shaped blade member having the inner end portion18 secured to the hub 15, and extending radially and circumferentially from the hub to an outer axial end edge. The adjacent vanes 17 extends from the hub 15 and form with the base 3 and shroud 16, a flow passageway 20 to outlet passageway 13. The top edge 19 of each vane is connected to the corresponding edges 19 of all other vanes 17 by the shroud 16, which is inclined to direct the water to flow downwardly and peripherally into passageways 20, 13 and outlet opening 14.

The hub 15 is specially formed, as shown in Fig. 1, with a center portion 21 and an outer encircling bottom wall portion 22 joined to the center portion by a curved concave wall 23 to which the vanes 17 are secured. The outer edge 24 of the bottom wall portion 22 is formed as a convex wall to a flat radial bottom wall 25 of the hub 15.

Each vane 17 is shown integrally formed 15, preferably as a single piece molded member with the hub at the curved concave wall 23 of the hub. Each vane 17 has the top edge 19 which curves from the center area and wall 23 of the hub outwardly to the shroud 16. The vane is inclined downwardly with the shroud 16 to the end adjacent the outlet passages 13 and opening 14. The shroud 16 is a round, plate member secured to the top inclined edges 19 of vanes 17. The shroud 16 includes an upper protrusion or enlargement 26 at the outer edge. The encircling housing cover includes

an overlying mating recess portion 26a mating with and slightly spaced from the enlargement 26 to complete the output passageway.

The vanes 17 extend axially beneath the hub 15 as at 27, generally to the vane connection of edge 19. The bottom edge portion of the vane 17 extends from beneath the hub 15 and is spaced upwardly of the adjacent wall 28 of the housing base 3. The wall 28 has a central recess or cavity 29, with a short center wall portion 30 extending radially of the seal 7 and an outer longer inclined wall portion 31 terminating in the horizontal wall 28 which extends beneath the vanes 17 outwardly of the hub and to the outlet opening 14. The cavity 29 forms a cooling chamber about the seal 7. The cavity 29 is connected to the water flow passageway 20 between the vanes at the convex outer edge 24 of the base wall portion 22.

The several vanes 17 are all connected to the hub 15 and project outwardly from the hub to the shroud 16 and base member in like spaced relation, as shown in Figs. 2 and 3, to form the curved water flow passageways 30 to the output passageway 13 and opening 14.

The outer end portion, generally inclusive of the convex outer edge 24, of the hub 15 and the radially inner end portion 34 of the shroud 16 overlap at 36 and form a first passageway or entry portion joined to the continuous passageway 20 between the vanes, shroud and topwall of the base 3 to the discharge passageway 13 and opening 14.

As a result of the above constructions, the water flow includes a first flow portion or stream 37 which flows directly from the housing chamber 12 through the radially inner portion of passageway 20 to the outlet passageway 13 and opening 14 as at the entrance portion beneath the shroud 16 and aligned hub base. A second or inner flow portion 38 of the water is beneath the flow portion 37. The second flow portion 38 flows around convex outer edge 24 of hub 15 and into the cavity 29 between the hub bottom wall and the wall of the housing base. The water of flow portion 38 moves into the cooling recess or cavity 29 around the seal 7, across the bottom wall 30 and the inclined wall 31 to the pump airflow passageway, when it merges with the stream 39 to pass into the output passageway 13 and opening 14.

In summary, the operation of the engine or other device, drives the impeller 10, and the vanes 17 drive the water from the housing 2 directly to the outlet

passageway 13 and opening 14, with part of the flow diverted through the seal cooling cavity 29 and therefrom, to the outlet passage 13, for discharge through opening 14.

The impeller 10 is preferably formed as an integral molded member in accordance with known molding technology, and particularly injection molding apparatus. The integral molded plastic impeller provides a low cost, long life unit which particularly contributes the long life of the pump unit.

Although shown in a preferred embodiment, the system of this invention includes the central passage defining support wall and the outer shroud defining wall arranged and connected as an integrated unit to form a water-directing passageway and flow in combination with a directed and impeller promoted seal cooling flow, and with the overlapping portions of the base and shroud with the two flows coupled to each other in the common end portion of the outlet passageway. The impeller is readily molded to particular flow specifications.

Various alternatives and embodiments are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter regarded as the invention.